Invasive Insects of Concern to Georgia

You can help stop their spread!

University of Georgia
Center for Invasive Species and Ecosystem Health
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What is an invasive species? An invasive species is any non-native organism whose introduction can cause harm to the environment, human health or economic interests. Some of the invasive species in this brochure are already serious pests in Georgia, yet some are not yet widespread. Twenty five non-native species that are or could be highly invasive in Georgia's forested, agricultural, natural or urban systems are highlighted in this publication.

How do invasive species get here? Invasive species are introduced through many means. Intentional introductions have often been for agricultural or ornamental purposes. Once introduced, some of these species escape their enclosures or cultivation and can become established as viable populations. Accidental introductions are usually the result of contaminated freight or movement of contaminated wood products (including shipping pallets, bracing and other dunnage), plants, or food products. Individuals or propagules (including its seeds, eggs, spores, or other biological material capable of propagation) of these invasive species can be contaminants or hitch-hikers in these shipments.

Are all exotic species invasive? No, actually only a small percent of introduced species ever become invasive. However, it is nearly impossible to predict which species will become invasive and new species are being introduced every day. Some species are present for many years before they exhibit invasive characteristics. Many invasive species go through a "lag phase" in which their populations grow slowly until they reach a size large enough for the population to explode and/or become adapted to the local environment and become invasive.

What type of harm does an invasive species do? Since invasive species are in a new environment, free from natural predators, parasites, or competitors, they often develop large population sizes very rapidly. These high populations can out-compete, displace or kill native species or can reduce wildlife food and habitat. Some also have the potential to disrupt vital ecosystem functions, such as water flow, nutrient cycling, or soil decomposition. Other invasive species cause massive amounts of economic damage to the agricultural business by destroying crops and contaminating produce. Some invasive species can cause direct harm to humans or domestic animals.

Why are the insects in this flyer of concern to Georgia? The insects discussed in this flyer have the potential to create significant damage or harm through direct losses to crops, forests, landscapes, man-made structures and aquatic environments. These insects can also cause environmental damage through wide-spread plant mortality. The presence of these pests may also result in quarantines being implemented by the US or other governments that restrict the import and export of a commodity.

None of the insects listed in this flyer are native to North America. Native insects can be pests but the introduction of exotic species has the potential to cause greater damage due to the lack of effective biological control agents and the lack of resistance in our native plants.

Why don't our native plants have resistance to these exotic insects? Plants developed resistance to insects through their interaction with the pest over many generations. The plants that were resistant survived to pass their survival characteristics on to the next generation. As a result, the plant species develops a set of effective defenses that allows the species to survive. When a new insect is introduced, the defenses of the plant are not prepared to counter the attacks of the new pest; therefore significant losses are often experienced.

What type of damage do these insects cause? Insects can damage plants in many different ways. They can cause direct damage, such as tunneling by wood boring insects can led to the death of the plant, or indirect damage, where the injury inflicted by the pest weakens the plant and renders it susceptible to other stress factors. The type of damage can be diagnostic in the identification of the pest.

Are all of these pests here now? No. Only 12 of the 25 species covered in this publication are known to be in North America. Three of them are known to currently be in Georgia.

How do we know that they will be a problem if they aren't here at this time? We don't, but there are many instances where an introduced pest is far more destructive on non-native hosts than those found in its native range. The full extent of the damage is not known until after an introduction is made. However, it is better to be cautious and watchful of these pests to limit the impact that an introduction may have.

What can I do to fight these exotic insects? The simplest and most important thing anybody can do to help fight invasive species is *to prevent its' introduction and establishment!* Invasive organisms can easily be transported on living plants or fresh products such as fruit. Many pests can be found in recently killed plant material including firewood, lumber, and wooden packing material. Avoiding the long range movement of these materials is a simple way to slow the spread of pests. Buying only certified pest-free nursery stock is also a good idea.

It is important to educate yourself and keep up to date on the status of these and other pests. Resources are available through your local extension office and on the web at ***www.bugwood.org*** and other websites. These resources have information on how to identify and control exotic pests that have already been introduced. By knowing what to look for and rapidly identifying any new introductions, we may be able to minimize the impact of new invaders. Report any occurrence of invasive species to your local county extension agent, Georgia Forestry Commission office, or to other federal or state natural resource or agricultural agencies. **Spread the word**; tell your neighbors if you see invasive species on their land. Volunteer with natural resource agencies to control invasive species. Control of small infestations is more effective and economical than trying to control a well-established, rapidly spreading infestation.

Photo by A. Battisti

Photo by L. Nageleisen

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Oak splendor beetle - *Agrilus biguttatus* (Fabricius)

Oak splendor beetle is native to Asia. It has not been found in North America. Like other metallic wood-boring beetles, including emerald ash borer, they are strong fliers which are able to fly several miles in search of a suitable host. They are readily moved in wood products such as firewood or other materials with attached bark. Oak is the primary host, but chestnut and beech are also susceptible. This beetle may have one generation a year in warm climates, but a two-year cycle is more common. Adult females feed on oak foliage before depositing clusters of 5-6 eggs in bark crevasses. The south side of large oaks (diameter at breast height of 11-15 inches) is preferred. Larvae feed in the cambium creating frass-filled, 'zig-zag' galleries. Mature larvae are creamy white, legless grubs around 1-1 3/4 inches in length. The first thoracic segment is wider than the other body segments. Two hornlike projections (urogomphi) are found on the last abdominal segment. Pupation occurs in the bark. The insect overwinters in both the larval and pupal stages. In May to June, adults emerge leaving D-shaped exit holes. Adults are attractive, metallic green, slender insects about 1/3 to 1/2 of an inch in length. The posterior third of the wing covers have two distinct white marks on their interior edge. Damage typically results in dieback, development of epicormic branches, thin crown, and tree mortality.

Photo from Penn. DCNR - Forestry Archives

Photo by D. Cappaert

Photo by D. Cappaert

Photo from Penn. DCNR - Forestry Archives

Emerald ash borer - *Agrilus planipennis* Fairmaire

Emerald ash borer (EAB) is native to Asia. It is known to be established in Michigan, Ontario, Ohio, Indiana, Illinois, and Maryland. EAB probably arrived in the United States on solid wood packing material from Asia. U.S. pathways include the movement of infested ash trees, limbs, firewood, logs, and untreated ash lumber. Hosts include all ash species; however, green ash, white ash, and black ash are more susceptible than Asian varieties. Females lay eggs 2 weeks after emergence. During this time, adults feed on the leaves, making them irregularly notched. Eggs are initially light-yellow, turning to brownish-yellow before hatching. Eggs hatch in 1-2 weeks, and the tiny larvae bore through the bark and into the cambium layer. The creamy white larvae are 1 – 1 1/4 inches long with flat, broad, segmented bodies. Larvae feed in the cambium creating S-shaped, frass-packed tunnels. Adults begin emerging in mid-June leaving 0.1 – 0.2 inches "D" shaped emergence holes. It is a small, brassy-green, metallic wood-boring beetle measuring 1/3 to 1/2 inches in length. Vertical splits in the bark are created by the tree forming callus tissue in response to larval feeding. The damage by the larvae causes general yellowing and thinning of the foliage followed by crown dieback and the eventual death of the tree. Basal sprouting and the presence of woodpeckers may indicate wood-boring beetle activity. After 1 to 2 years of infestation, the bark often falls off in pieces from damaged trees, exposing the insect galleries. The life cycle in Michigan takes between 1-2 years.

Photo by A. Wagner, USDA APHIS PPQ

Photo by A. Wagner, USDA APHIS PPQ

Citrus longhorned beetle
Anoplophora chinensis (Forster)

Citrus longhorned beetle is native to Asia and occurs primarily in China, Korea, and Japan. It has been found in, and eradicated from, Georgia, Wisconsin, and Washington. It was most likely introduced on wood packing material or in live plant material. It is known to attack and kill more than 100 species of plants and includes several species in the Citrus genus as well as peach, cherry, pecan, maple, oak, ash, elm, and walnut. Larvae are white, opaque, legless grubs typical of longhorned beetles. When mature, they are 1 3/ 4 to 2 1/3 inches long and about 1/3 of an inch wide with an amber colored head and black mouthparts. Adults emerge from April to August. Adults are 1 – 1 1/2 inches long and shiny black with white markings. Antennae are at least as long as the body and have alternating black and white bands. The ventral surface is pubescent. The color of the pubescence varies from white to blue depending on location. An important identifying characteristic of Citrus longhorned beetle is the presence of two pairs of polished white bumps at the base of the elytra. These are visible with a 10x hand lens and are not present on the Asian longhorn beetle, *Anoplophora glabripennis*. Damage includes distinct round or slightly oval shaped adult exit holes on the bark surface, T-shaped oviposition holes, sawdust-like frass or wood pulp around small holes, and larval tunnels in the wood under loose or thin bark.

Photo by M. Bohne, USDA Forest Service

Photo by M. Bohne, USDA Forest Service

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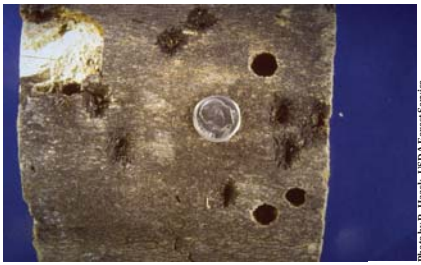

Photo by R. Haack, USDA Forest Service

Asian longhorned beetle

Anoplophora glabripennis (Motschulsky)

Asian longhorned beetle is native to China and other nearby Pacific Rim countries. It was introduced in Chicago, Illinois and the New York City area through solid wood packing material from China. Domestically, movement of infested tree-based materials, including logs and firewood, can easily spread this insect. It is known to attack at least 18 species of hardwood trees including maple, birch, horse chestnut, poplar, willow, elm, ash, and black locust. Adult females chew out a place to lay their eggs forming oval to round, darkened wounds in the bark. Eggs are laid singly and they secrete a substance that hardens over and protects the egg. Larvae develop out of the eggs and chew banana-shaped galleries into the heartwood, on which they will feed in during fall and winter. The pale-yellow larvae are worm-like, elongate, and cylindrical with a varied texture on the underside; the eighth segment of the abdomen has a protruding structure. Pupae are off-white, 1 to 1 1/4 inch long and 1/3 of an inch wide. Adults emerge during the spring through large round holes (3/8" diameter) that may occur anywhere on the tree including branches, trunk, and exposed roots. These exit holes can number in the thousands per tree. Adult beetles 1 to 1 1/2 inches long, shiny-black with white spots. They have black-and-white banded antennae that are at least as long as their bodies. The upper sections of the legs of the adults are whitish-blue. Asian longhorned beetle can be distinguished from related species, such as citrus longhorned beetle, by the markings on the wing covers and the pattern of the antennae. Asian longhorned beetles require between one to three years to reach maturity.

Photo by R. Dzwonkowski

Photo by R. Dzwonkowski

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Photo by R. Hoebeke, Cornell

Pine Shoot Beetles - *Tomicus* spp.

There are several *Tomicus* species that feed on various conifers. Many are familiar with *Tomicus piniperda*, the common pine shoot beetle, since it was identified near Cleveland, Ohio in 1992. Two other species, *T. minor* and *T. destruens*, are not known to be present in the United States. Probable introduction pathways include: unprocessed logs, fire wood, tree trimmings, and lumber with the bark still attached. Pines are the most common host, although *T. piniperda* may attack fir, larch, or Douglas fir. *T. minor* has also been reported on larch. Both *T. piniperda* and *T. minor* have one generation per year. For *T. destruens*, two to three overlapping generations per year are suspected; however, current theories suggest they may actually be multiple broods resulting from mated females attacking multiple trees. After mating, females construct egg galleries within the inner bark and outer sapwood. Eggs are pearly white. After hatching, larvae construct feeding galleries. Larvae are white, c-shaped, legless grubs with an amber colored head capsule which may be as long as 1/8 inch when mature. Pupation can occur, in cells, at the end of the larval galleries or in the bark. Pupae are white with some adult features, including rudimentary wings. Adults emerge and feed by boring into tender pine shoots. This feeding may occur as a mass attack on susceptible trees. Attacks are characterized by reddish brown boring dust on the bark surface of trees and, if relatively vigorous trees are attacked, conspicuous pitch tubes on the bark surface. Reddening or browning of shoots is also common. Adults are dark-brown, elongate and about 3/16 inch in length. The ends of the wing covers bear features to distinguish between the various species. The head is visible, when viewed from above, and has six-segmented red-yellow antennal clubs. Blue stain fungi or other vascular wilts are commonly associated with these beetles.

Photo by J. Johnson, GFC

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Photo by M. Thomas, Florida DOACS

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Redbay ambrosia beetle

Xyleborus glabratus Eichhoff

Redbay ambrosia beetle was introduced into the United States from Asia in 2002, most likely in solid wood packing materials, such as crates and pallets. By 2005, it was found to be consistently associated with mortality in an expanded area of coastal South Carolina and Georgia. The range of redbay ambrosia beetle and associated redbay mortality continues to expand in Florida and coastal areas across the Southeast. Potential hosts include all members of the Lauraceae family such as Asian spicebush, yellow litsea, redbay, and sassafras. The threatened and endangered species: pondspice and pondberry are of partiticular concern. The larvae are typical of scolytid beetles and are white, c-shaped, legless grubs with an amber colored head capsule. Adults are minute (1/16 inch), slender, and brown-black in color. Upon emergence, only the females seek a new host. Not much is known about this beetle's life cycle, but it is assumed to be similar to other *Xyleborus* beetles. Adults tend to attack weakened or recently killed hosts. Attacks are evident by pinhole-sized holes in the bark associated with either pitch flow or light-colored boring dust. Investigation under the bark often reveals galleries. As with other ambrosia beetles, the beetle transmits laurel wilt (*Raffaelea lauricola*) which serves as a food source for the beetle and also causes infected plants to rapidly wilt and die.


Photo by P. Weston, Cornell


Photo by P. Weston, Cornell

Photo by P. Weston, Cornell


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Viburnum leaf beetle - *Pyrrhalta viburni* Paykull

Viburnum leaf beetle is a native of Europe. It is known to be established in New York, Maine, New Hampshire, Vermont, Washington State, and a small part of Pennsylvania and Ohio. It is mainly moved on infested live viburnums. Hosts include Viburnum species, especially arrowwood viburnum, European cranberrybush viburnum and mapleleaf viburnum. Adults are 1/4 to 1/3 of an inch long. The head, thorax, and elytra (wing covers) are generally brownish and the shoulders of the elytra are darker. The dorsal (back) surface has small, dense punctures, and the space between punctures is covered with thick, golden-grey pubescence. Females deposit up to five eggs in holes dug in new growth. The hole is capped with cement made from plant fiber, spit and a little excrement. These are visible throughout the summer, fall, and winter months. Egg hatch usually occurs in early May. These young larvae are greenish-yellow and skeletonize viburnum foliage, usually starting with lower leaves and leaving only midribs and major veins intact. As the larvae mature, they grow to about 1/3 of an inch long, darken and develop a series of dark spots. Mature larvae migrate to the soil to pupate. Adults emerge from the soil and return to feeding on foliage. Adult feeding damage consists of irregular circular holes, and severe feeding can nearly defoliate shrubs once again. When disturbed, the beetles will fly away or drop to the ground. Skeletonized leaves in the spring (May-June) and heavily chewed leaves in the summer (July-September) indicate a viburnum leaf beetle infestation. The span from egg hatch to adult can be as quick as two months. Despite this, only one generation per year has been reported.

Photo by G. Bernon, USDA APHIS

Photo by D. Lance, USDA APHIS PPQ

Photo by G. Bernon, USDA APHIS

Photo by D. Lance, USDA APHIS PPQ

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Brown marmorated stinkbug - *Halyomorpha halys* (Stal)

The Brown marmorated stinkbug is native to Asia. It is known to be established in Pennsylvania, New Jersey, and Oregon. Hosts include maple, serviceberry, birch, butterflybush, pepper, pecan, catalpa, hackberry, redbud, citrus, dogwood, cucumber, fig, sunflower, honeysuckle, tomato, apple, plum, pear, rose, lilac, linden, viburnum and grape. Adults emerge from overwintering in April. Eggs are 1/16 of an inch, pale green and laid from June to August. Most egg masses have about 25 eggs. The nymphal stages do not have developed wings. All instars have deep red eyes. Size ranges from 1/8 to 3/4 of an inch as the insect grows and molts. Nymphs are first red, turning almost black, and then finally becoming brown as adults. They are the typical "shield" shape of other stink bugs, almost as wide as they are long. Injuries caused by feeding produce small necrotic areas on the outer surface of fruits and leaves. Scarring is common on fruits such as apple and peach. On other plants may have roughly-circular stippled areas about 1/8 inch wide. Only one generation has been observed; however, there are likely to be multiple generations as it spreads south. Adults begin overwintering at the end of September and become a nuisance as large numbers congregate and invade buildings in search of overwintering sites.

Photo by W. Ciesla

Photo by W. Ciesla

Photo from Penn. DCNR - Forestry Archives

Photo by M. Montgomery, USDA Forest Service

Hemlock woolly adelgid - *Adelges tsugae* Annand

Hemlock woolly adelgid (HWA) is native to Japan and possibly China. It was first observed in western North America in the early 1920's and had moved east to Virginia by the 1950's. In the eastern United States, HWA is now found from northern Georgia, north along the Appalachian Mountains to southern New England. Movement of live infested hemlocks, wind, birds, and mammals disperse it on a local scale. Hosts include forest and ornamental hemlock trees (*Tsuga* spp.). HWA is a serious pest of eastern hemlock and Carolina hemlock. Size varies from 1/16 to 1/ 8 of an inch in length with piercing/ sucking mouthparts. All adults are female with each female producing 50-300 eggs in a lifetime. It produces increasing amounts of white, woolly wax used to protect itself and its eggs. A sign of infestation is the presence of what appears to be the tips of cotton swabs on the bases of needles. Needle loss and twig desiccation, caused by the insects feeding, hinders shoot growth. Needle loss is followed by twig die-back, defoliation, and death, usually within four to six years of infestation. Severe infestations can eliminate the hemlock component from forest stands.

Photo by D. Meyerdirk, USDA APHIS PPQ

Photo by D. Meyerdirk, USDA APHIS PPQ

Pink hibiscus mealybug - *Maconellicoccus hirsutus* (Green)

Pink hibiscus mealybug (PHMB) is established in most tropical areas of the world including Africa, India, Australia, and Asia. It is a serious pest in Hawaii, the Caribbean and has been found in southern California and Florida. Movement of infested plants and fruits, as well as, dispersal by wind, birds, and wildlife provide an opportunity to introduce the pest. More than 200 species of trees, plants, and shrubs are known hosts; including beans, chrysanthemum, citrus, coconut, coffee, cotton, corn, croton, cucumber, grape, guava, hibiscus, peanut, pumpkin, rose, and mulberry. Eggs are pink, minute, and contained in an egg sack of white wax. Newly hatched nymphs are called "crawlers" since the nymphal stage is wingless. Both males and females have active nymphal stages. The male has an inactive stage in which with wing buds form within a cocoon of mealy wax. Both female and male adult hibiscus mealybugs are about 1/8 inch (3 mm) long. Female bodies are pink, wingless, and covered by a mass of white mealy wax, just like the nymphs. When squished, the bodily fluid is reddish. Males have a pair of wings, two long waxy tails and can fly. Reproduction continues through parthenogenesis if there are no males. PHMB usually completes its entire cycle in 23 - 30 days and under optimum conditions 15 generations a year are possible. Feeding by nymphs and adults results in stunting, shriveled fruit, poor fruit set, deformed leaves and shoots, and sometimes death. Infested fruits may be entirely covered with the white waxy coating of the mealybug. Sooty mold may develop on honeydew secretions of the mealybug.


Photo by G. Pellizzari


Photo by G. Pellizzari

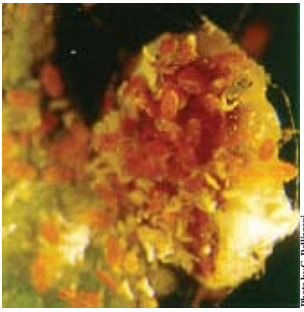


Photo by G. Pellizzari


Photo by G. Pellizzari

Japanese wax scale - ***Ceroplastes japonicus*** Green

Japanese wax scale is an Asian native that has also been found in Europe. It is not known to currently occur in the United States. Hosts include maple, boxwood, citrus, hawthorn, euonymus, fig, holly, apple, stone fruits, pear, willow, and elm. Males are not known to exist for this species. The females lay eggs starting in May. Each female may lay up to 1,700 eggs under their protective covering of oily wax. The number of eggs is highly dependent on the host it is feeding upon. Egg hatch begins in June and the small scales (crawlers) search for a location to settle and feed for the majority of their lives. These first instars may also be moved by wind, animals, or on infested plant material. As they settle and begin to feed, crawlers exude a thick layer of grayish to pinkish-white, oily wax. Like other soft scales, their feeding often produces chlorotic lesions and a sticky layer of honeydew which becomes covered with black sooty mold. Other symptoms may include wilting and dieback. Only one generation per year has been observed.

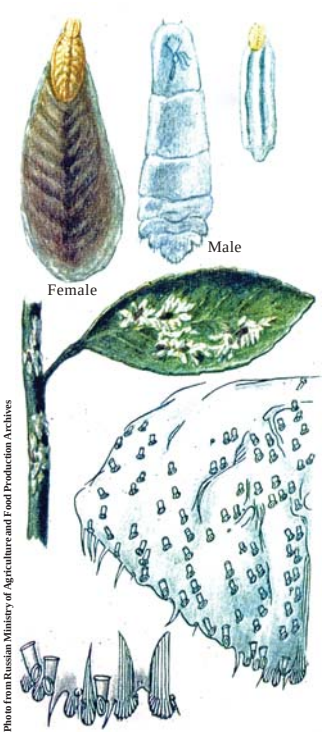


Photo from Russian Ministry of Agriculture and Food Production Archives

Photo from http://perso.orange.fr/scanico/cochenille.htm

Arrowhead scale - ***Unaspis yanonensis*** Kuwana

Arrowhead scale is considered native to China but has invaded and spread though much of Japan, France, and Italy. It is not known to occur in the U.S. Infested live plants or fruit provide the main method of introduction to other localities. Hosts include all citrus, especially oranges, but also a wide range of other crops, including bananas, coconuts, guavas, hibiscus, jackfruits, kumquats, and pineapples. The eggs of the first generation are laid under the armor of the adult female. The orange-yellow egg is entirely smooth and oval. In citrus-producing areas of the United States, egg laying will most likely begin in February or March with each female producing about 200 eggs. The first larval stage (crawler) is an active, flat, oval-shaped, pale-yellow creature with purple eyes. After the first molt the legs are lost and the antennae are reduced to a single segment. The body of the adult female does not change much from this form. Male nymphs have a prepupal stage leading to a winged adult. The prepupa is orange-yellow with dark purple-brown eyes. The rudimentary antennae, legs, and wings are visible. The winged male is orange-yellow with deep dark brownish-purple eyes and is 1/ 16 of an inch long. A light brown band can be seen across the thorax. The abdomen narrows at the end and has a sharp style. Female scale covers are mussel-shell shaped 1/8 of an inch, slightly convex, blackish-brown with a paler margin. The scale cover of the male is smaller than that of the female, white, and elongate oval in shape. There are 2 to 4 generations per year and development is strongly influenced by air temperatures. Feeding of the insect produces chlorotic-necrotic spots, irregular growth, and limb dieback, as well as malformation of fruit and premature drop.


Photo by D. Haugen, USDA Forest Service


Photo by D. Lance, USDA APHIS PPQ


Photo by D. Lance, USDA APHIS PPQ

Photo by D. Haugen, USDA Forest Service


Photo by D. Haugen, USDA Forest Service

Sirex woodwasp - *Sirex noctilio* Fabricius

Sirex woodwasp is native to Europe, Asia, and northern Africa. It has been introduced to New Zealand, Australia, Uruguay, Argentina, Brazil, Chile, and South Africa as well as Indiana and New York. The most common method of introduction has been on solid wood packing material as well as in untreated or dried logs and saw timber. It attacks a wide variety of pines including Monterey, loblolly, slash and shortleaf. The female drills into the wood and inserts a toxic mucous and the fungus *Amylostereum areolatum* along with her eggs. The mucus prevents anti-fungal toxins from being formed at the site of infection. The fungus grows in the wood causing it to dry out and the trees die in a few weeks or months. The eggs are white, soft, smooth and elongate. Larvae are creamy white and legless with a distinctive dark spine at the rear of the abdomen. The frass-filled larval galleries become 'horse-shoe' or 'u-shaped' as the larvae tunnel towards the heartwood, but then turn back towards the sapwood. Larvae feed on the fungus, which has converted the wood cellulose into a more easily digestible form. The pupae formed in the outer layers of the sapwood are initially creamy-white and gradually assume the color of the adults. In July, large round holes are left as adults emerge and begin searching for new hosts. The adult is a large, robust insect, usually 1 to 1 1/2 inches long. Adult females have dark metallic blue or black bodies with orange legs. The head and thorax of the males are metallic blue. The abdomen is orange at the center and black at the base. Sirex woodwasp is expected to complete one generation per year throughout most of the United States. The most important symptom is the progressive and irreversible chlorosis in the crown, followed by a sudden wilting of the foliage, heavy needle fall, and finally death and decay. Initially it is important to inspect the surfaces of stems for resin drops released after eggs are laid. Narrow bands of brownish fungal stain in the outer sapwood can be noted in infested trees. In general, Sirex woodwasp attacks living pines, while native woodwasps attack only dead, weakened, or dying trees.

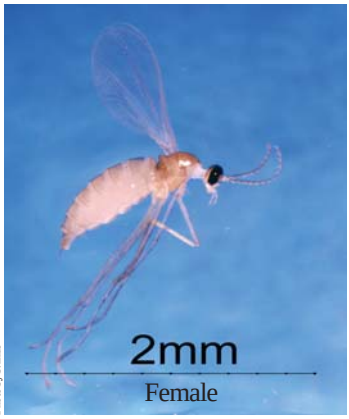


Photo by S. Ellis

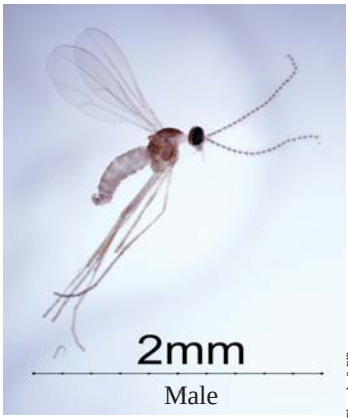


Photo by S. Ellis

Photo by M. Chen, Cornell

Photo by J. Kikkert, Cornell

Swede midge - *Contarinia nasturtii* (Kieffer)

Swede midge is native to Europe and southwestern Asia. It was confirmed to be present in Ontario and Québec, Canada and has been detected in New York. Since the adults are weak fliers, it was most likely introduced through the movement of infested plants or soil. Hosts of this pest are plants in the family Brassicaceae: and includes plants such as broccoli, cauliflower, collard, kale, cabbage, and radish. The number of generations per year is dependent on the climate, with as many as 4 generations per year in parts of Europe and 3 per year in Ontario. Adults of the overwintering generation begin to emerge at the end of May. The female lays eggs in strings or clusters of 15-20 eggs on the youngest parts of the plant. The extremely small eggs are laid on a stalk. After three days, the eggs hatch and most larvae will start to feed near the growing point. The larvae are pale to lemon-yellow and legless. When full grown, they can be up to 1/16 of an inch in length. Their saliva digests plant tissue, resulting in the flower (i.e. head of broccoli or the like) becoming deformed and unmarketable. The damage by the insect also favors the development of plant-rotting fungi and bacteria. After 2-3 weeks the larvae drop to the ground and spin cocoons. Two weeks later the next generation of flies appear. Adults are 1/16 of an inch in length with iridescent wings. The abdomen has indistinct transverse stripes. The ovipositor of females is whitish and can extend to become pointed like a needle. The shield behind the head is slate gray with two lengthwise, shiny-black furrows. Females become inactive at temperatures below 68 ºF (20 ºC). During periods of drought, the larvae may become dormant, but growth resumes after a rainfall. Feeding damage is easily confused with mechanical injury from cultivation, feeding by other insects and animals, molybdenum deficiency, herbicide injury, genetic variation of the plant, and heat or cold stress.

Photo by H. Ovidiu

Photo by T. Tigner, Va. Dept. of Forestry

Photo from Penn. DCNR- Forestry

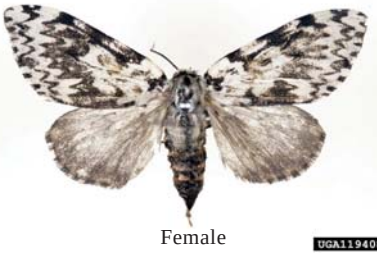
Gypsy moth - ***Lymantria dispar*** (Linnaeus)

The gypsy moth, currently established in North America, is a European native that was accidentally introduced into New England in the late 1800's during an attempt to rear an alternative silk producing insect. Its current range extends from Maine to North Carolina and west across Pennsylvania and into Virginia, West Virginia, Ohio, Michigan, and Wisconsin. Spread occurs as a result of both natural flight of the moth and the attachment and transport of egg masses on vehicles. Gypsy moth is known to feed on over 300 trees and shrubs. Favored hosts include oak, apple, alder, basswood, birch, poplar, sweet gum, willow, and hawthorn. Less favored host species include hickory, maple, cherry, cottonwood, elm, black gum, larch, sassafras, and hornbeam. Some mortality even occurs in white pine. Many other plants may be fed upon. The gypsy moth has one generation per year. From June to mid-July, the female attaches buff-colored, velvety egg masses to sheltered places on outdoor objects. These masses allow the insect to overwinter and may contain up to 1,000 eggs. Masses are also embedded with female abdominal hairs that may act as an allergen. The eggs hatch in April or May. Young larvae chew small holes in leaves, while older larvae consume entire leaves except for the larger veins and midribs. The whole tree may be defoliated, resulting in reduced growth and loss of vigor, as well as reduced aesthetic, recreational, and wildlife values. If total defoliation is experienced over several years, mortality may result. The older caterpillars are 1 1/2 – 2 1/2 inches long and are easy to identify by the tufts of hair on each segment and the pattern of blue and red dots on their backs. The gypsy moth pupates in dark brown pupal cases located in sheltered locations. Male gypsy moths have a 1 1/2 inch wingspread with light tan to brown wings marked with wavy, dark bands across the forewing. Females are white, larger than males with a wingspread of 2 1/2 inches, and flightless. There is also an Asian strain of the gypsy moth (AGM) that was identified in 1991. AGM has a much broader host range and the females are active fliers due to their larger wingspan. These factors would allow AGM to spread much faster than the European strain and be even more damaging.

Photo by D. Adam

Male

Photo from DAFF Archives



Female

Photo from DAFF Archives

Nun moth - *Lymantria monacha* (Linnaeus)

Nun moth is a native of Europe. It is not known to be established in North America. Egg masses on crates, pallets of other packing materials are the most likely route of entry. Hosts include Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*); however, the majority of conifers and broad-leaved tree species may also be hosts. Mated females deposit eggs in bark crevices under scales or lichens. The round eggs have a diameter of about 1/16 of an inch and are grayish brown. In late April or early May (at a temperature of about 50 – 60 °F) young caterpillars hatch, climb to the crown, and feed on young needles and male flowers. The newly hatched caterpillars are 1/8 of an inch long and have long hair that disappears after the first molt. Caterpillars molt 5-6 times. After the third molt, caterpillars gain their characteristic color. Caterpillars, characteristically, have a grayish-yellow head with black and brown spots, and bodies dark with light spots on the third, seventh, and eighth segments. There are tufts of hair of various lengths on the sides of the body. One caterpillar can damage about 300 Scots pine needles or 1,000 Norway spruce needles during its development. If a spruce tree is defoliated more than 50% it usually dies, however the Scots pine is more resistant than most conifer species. Pupae are 1/2 to 3/4 of an inch long. They change from green to dark brown/metallic black and develop tufts of white hair. Adults emerge and swarm from July through August and sometimes into mid-September. During the day the moths usually stay on lower parts of tree trunks, and at night males fly up to a third of a mile to find females. Females are 1/2 to 3/4 of an inch long with a 1 3/4 to 2 1/4 inch wingspan, and males are about 1/2 of an inch long with a 1 1/3 to 1 3/4 inch wingspan. Female antennae are thread-like, while male antennae are comb-shaped. The forewings of both sexes are white with wavy, dark bands. The hindwings are brownish-gray. However, color varies from white to dark forms.

Photo by J. Sohn

Photo by J. Sohn

Summer fruit tortrix moth
Adoxophyes orana (Fischer von Rosslertamm)

The summer fruit tortrix moth is native to Europe and Asia but is not known to occur in the United States. It is a pest of apple, cherry, and pear, but also feeds on other Rosaceous hosts, as well as maple, alder, peanut, birch, hawthorn, forsythia, ash, honeysuckle, alfalfa, poplar, oak, rose, willow, elm, and lilac. Females lay yellow masses of eggs in early spring. The larvae hatch and leave behind the transparent shell of the eggs. The head of the larvae is light brown to yellow. It has a greenish body ornamented with warts and light hairs. When disturbed, the larvae spin a silken thread and descend to escape. This thread is also a possible method for movement via wind. Mature larvae spin a 1/ 3 to 1/2 of an inch cocoon before molting into light brown pupae. Pupae will darken as it matures. Adult moths are 1/3 to 1/2 of an inch long with brownish wings marked in a variable dark-brown pattern. Males are smaller than females and have brighter colors. Two to three generations may occur per year, depending on temperature. On apple, it can be expected that damage from the first generation will result in large deep holes where as the second generation produces small holes of less than 1/5 of an inch in diameter.

Photo by T. Grove

Photo by J. Hofmeyr

Photo by J. Hofmeyr

Photo by J. Hofmeyr

False codling moth
Thaumatotibia leucotreta (Meyrick)

False codling moth is native to Ethiopia and sub-Saharan Africa. It is not known to be established in North America. Main routes of introduction are larvae on fruits, pods, or flowers. There are more than 70 potential U.S. hosts including: okra, mallow, acacia, pineapple, pepper, tea, pecan, citrus, coffee, persimmon, fig, cotton, hibiscus, walnut, macadamia, mango, banana, olive, avocado, bean, yellowwood, apricot, plum, guava, pomegranate, oak, sorghum, and grape. The time for development is highly temperature dependant with up to five generations per year in South Africa. A female moth can lay up to 400 flattened-oval, pin-head sized eggs, usually placed singly. Young caterpillars are yellowish-white with dark spots. Larvae can grow to be 1/2 inch in length and are bright red or pink with a yellow-brown head. On citrus, young larvae mine into the fruit, causing premature ripening. External indications may be seen as scarring on the fruit. On cotton it first mines the boll wall, but later transfers to the seeds. This feeding habit leaves few indications of the feeding being done inside the seeds. When mature, the larva descends to the ground on a silken thread and spins a tough silken cocoon in the soil and duff. Males and female adults have distinctly different patterns. The wingspan ranges from 1/2 to 3/4 of an inch. Both genders have patterns on the forewing of grey, brown, black and orange-brown markings. The male's hindwing is slightly reduced with a circular pocket of fine, hair-like black scales overlaid and broad, whitish scales in the anal angle.


Photo by B. Franson


Photo by E. Hegazi


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Photo by E. Hegazi

Egyptian cottonworm
Spodoptera littoralis (Boisduval)

Egyptian cottonworm is native to Africa. It has been intercepted at US ports, but is not known to be established in North America. Host plants include okra, onion, pigweed, peanut, cabbage, cauliflower, pepper, citrus, taro, tea, cucurbits, carrot, fig, geranium, soybean, cotton, sunflower, tomato, lettuce, apple, alfalfa, tobacco, avocado, pine, pea, poplar, plum, pear, oak, potato, eggplant, spinach, clover, wheat, and corn. Adult females lay their whitish-yellow eggs in masses on the lower surfaces of young leaves with hair scales from their abdomen. The hairless larvae are blackish-grey to dark green, eventually becoming reddish-brown or whitish-yellow as they mature. Dark and light longitudinal bands and two dark, semi-lunar spots on their back help to identify this caterpillar. Larvae begin feeding on the underside of leaves, but move to the upper surface as they mature. Feeding may also occur on fruits, pods, and stems of plants. When fully grown, they can be 1 1/2 to 1 3/4 inches in length. It pupates 1/2 inches below the surface of the soil in a clay cocoon. When the pupae form, they are green with a reddish color on the abdomen but they rapidly turn dark reddish-brown. The gray-brown adult is marked by grey to reddish-brown forewings with paler lines along the veins. The hindwings are grayish-white, iridescent with grey margins and usually lack darker veins. The adults generally fly a couple hours before midnight. In Egypt, seven overlapping generations have been observed on cotton.

Old world bollworm - *Helicoverpa armigera* (Hübner)

Old world bollworm is native to Europe and Asia. It is not known to be established in North America. Possible routes for introduction include imported cuttings, fruits, vegetables, and flowers, as well as hitchhiking on aircraft. This species is a general feeder and is highly resistant to pesticides. Hosts include a wide variety of fruits, vegetables, weeds, ornamental plants, and flowers. A partial list includes pine, larch, crab apple, artichoke, barley, carrot, coffee, mango, alfalfa, cotton, tobacco, tomatoes, okra, onion, peppers, leek, clover, potatoes, wheat, maize, flax, soybean, sorghum, rice, millet, lucerne, strawberry, chickpeas, crucifers, legumes, cucurbits, *Prunus* spp., citrus, *Amaranth* spp., and sow thistle. In summer, a life cycle can be completed in 5 to 7 weeks. Following generations feed on other plantings of the same crop or on other hosts. One female moth may lay up to 1,500 eggs. The dome-like eggs have a ribbed surface and are pearly white when laid, but change to brown as they develop. The young caterpillars are predominantly green but the colors vary through development. When mature, larvae may be up to 2 inches long and usually have striped patterns over a base color that ranges from light green to brown to black. Distinct hairs are visible when held up to the light. Larval development takes 2 to 3 weeks before pupation occurs in the soil. The reddish- brown pupa stays in the soil for 10 to 14 days when not overwintering. Adults have light fawn forewings with a kidney-shaped spot in the middle. Hindwings are grey to grey-brown. Both wings have a broad dark band on the outer third of the wing but the band on the hind wing has a pale patch in the middle of the dark band. When resting, the wings are held roof-like over the body.

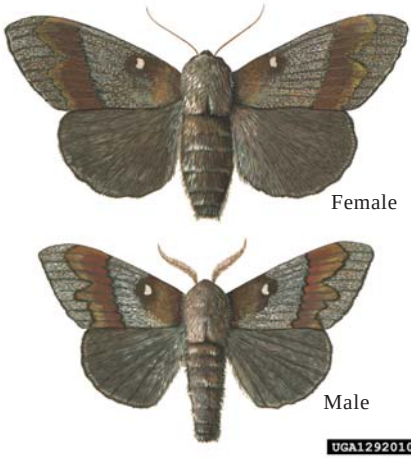

Photo by R. Dzwonkowski

Photo by W. Ciesla

Photo by H. Lemme

Photo by S. Kinelski

Pine-tree lappet - *Dendrolimus pini* (Linnaeus)

Pine-tree lappet or pine moth is a European native, but is also known in the western part of Asia. It has not yet been detected in North America. The most likely method of introduction would be eggs and pupae hidden in the bark crevasses of unprocessed logs. Hosts are a wide range of conifers including fir, cedar, juniper, spruce, pine, Douglas-fir, and larch. From late-June through August, adult females lay eggs in groups of about 100. Females do not fly until after they have laid some of their eggs. The pinhead-sized (1/16 inch) eggs are blue-green when first deposited, later turning gray. Eggs hatch in about 14 days. Caterpillars first feed on egg shells, then on needles. First instar larvae can be wind dispersed as well as crawl significant distances to reach uninfested trees. One larva may consume up to 1,000 needles. When no needles are present, the bark of young shoots is also eaten. Mature larvae are 2-3 inches long with soft, gray-to-brownish hairs. Identifying features of the caterpillar include thick bands of steel blue and black hairs on the thorax and a black mark flanked by irregular white lines on the abdominal segments. After the first frost, caterpillars move to the litter on the forest floor to overwinter. The following spring, they return to the canopy to resume feeding. In June, yellow-brown to black cocoons marked with steel blue hairs start being formed in bark crevices and on needles and branches. Adults emerge in roughly 4 weeks. Identifying features of the 2 to 3 1/2 inch moth include gray-brown to brown forewings with a reddish brown lateral band and an irregular dark-brown to black stripe along the edges. Hind wings are red brown to gray brown. Males are usually darker than females.

Photo by J. Ghent, USDA Forest Service

Photo by J. Ghent, USDA Forest Service

Photo by J. Ghent, USDA Forest Service

Siberian silk moth

Dendrolimus superans sibiricus Tschetverikov

Siberian silk moth is a major pest of conifers and is native to Northern Asia. It is not yet known to be in North America. Eggs and larvae may be especially problematic as hitchhikers in packing material, although any life stage can be found in plant material. Development usually lasts 2 years but it may vary from 1 to 3 years depending on temperature. Adults fly from the end of May to the middle of July. Immediately after mating, females lay eggs on the needles, mainly in the lower crown, but also on the ground. Newly laid eggs are light-green, but soon become creamy white and then darker and spotted. Eggs have a 13-15 day development period. The black to dark-brown caterpillar has numerous spots and long hairs. The 2nd and 3rd segments crossed by blue-black stripes. Larvae feed until late autumn and spend the first winter in forest litter. In spring, after snow melt, caterpillars climb up to the crown and feed for the entire summer before returning to the forest litter for their second winter. In spring they begin to feed intensively and pupate in May-June in cocoons made from crude web. Cocoons can be found in crowns, on branches, or stems. The pupa is brown and 1 1/4 inches long. Adult wingspan ranges from 1 1/2 to 3 inches with a body length of 1 1/4 inches. The color of moths varies from light yellowish-brown or light grey to dark brown to almost black. Front wings are distinctively marked with two characteristic crossing dark stripes and a white spot in the center.

Photo by I. Baez

Photo by S. Ellis

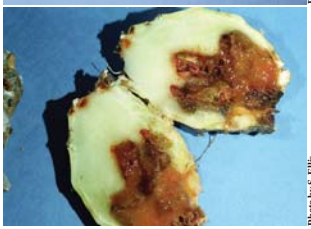

Photo by S. Ellis

Photo by S. Ellis

Photo by S. Ellis

Cactus Moth - *Cactoblastis cactorum* (Berg)

Cactus Moth is native to Argentina, Paraguay, Uruguay and southern Brazil. It is known to be established in Florida, Georgia, and South Carolina. Hosts include cactus species such as prickly-pear. The female lays a long chain of eggs at the end of a cactus spine. The resulting 'egg-stick' resembles the spine of the cactus. After hatching, the pinkish-cream colored larvae burrow into the pad of the plant. Larvae move in groups as they feed and also push the frass onto the ground, often forming significant piles. The space inside the plant is reduced to a green mass of goo as the larvae feed. As they grow, caterpillars become orange with dark red bands across each segment. Once mature, they are about 1 to 1 1/2 of an inch long. They leave the plant and form a white cocoon on the ground, either in a protected crevice of a nearby tree or just among the debris. The adult has a 1 to 1 1/ 2 inch wingspan with faint dark dots and lines on the light tan wings. At rest, its wings wrap around its body. In Queensland, Australia, there are two generations per year. It is expected that development would occur faster in the warm climate of Florida.

Glossary

Callus tissue – special tissue produced by a tree when wounded to cover and protect the wound.
Cambium – layer of cell beneath the bark that give rise to xylem (wood) and phloem (inner bark).
Dorsal – referring to the back of an insect
Elytra – hardened "wing covers" on beetles.
Emergence – new adults coming out from their pupation site
Epicormic branches – sprouts forming from the trunk or base of a tree. Often called suckers or water sprouts.
Frass – insect "poop". In the case of wood borers, it often resembles sawdust. In foliage feeding insects, it often looks like dark brown pellets.
Larvae – An immature form of an insect that does not resembles the adult. This includes caterpillars, maggots and grubs
Molt – the process that an insect goes through to move from one life stage to the next.
Nymph – An immature form of an insect that resembles the adult
Oviposition – egg laying
Pubescence – A covering of short fuzzy hairs
Pupae – A stage that some insects go through as they transition between a larvae and an adult

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Georgia Invasive Species Task Force

A cooperative approach, to help minimize the impacts of invasive species to Georgia's agricultural and natural resources, between:

University of Georgia
Center for Invasive Species and Ecosystem Health
College of Agricultural and Environmental Sciences
Warnell School of Forestry and Natural Resources
Georgia Department of Agriculture
USDA APHIS Plant Protection and Quarantine
Georgia Forestry Commission
USDA Forest Service

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www.invasive.org

Images and Information on Invasive/Exotic Plants, Insects, Diseases and Biocontrol Agents